

According to one embodiment of the invention, the electrically conductive polymer coating is applied to an acid-dissolvable substrate metal (e.g., Al) which had previously been coated with a layer of oxidizable/passivating metal such as stainless steel. In this regard, a barrier/protective layer 96 of a metal that forms a low resistance, passivating oxide film is deposited onto the substrate 98, and is covered with a topcoat of conductive polymer 54 in accordance with the present invention. Stainless steels rich in chromium (i.e., at least 16% by weight), nickel (i.e., at least 20% by weight), and molybdenum (i.e., at least 3% by weight) are seen to be excellent such barrier/protective layers 96 as they form a dense oxide layer at the sites of the micropores in the polymer coating which inhibits further corrosion, but which does not significantly increase the fuel cell's internal resistance. One such stainless steel for this purpose is commercially available from the Rolled Alloy Company as alloy Al-6XN, and contains 23±2% by weight chromium, 21±2% by weight nickel, and 6±2% by weight molybdenum. The barrier/protective stainless steel layer is preferably deposited onto the metal substrate using conventional physical vapor deposition (PVD) techniques (e.g., sputtering), or chemical vapor deposition (CVD) techniques known to those skilled in these art. Alternatively, electrolessly deposited nickel-phosphorous alloys appear to have good potential as a substitute for the stainless steel in that they readily form a passivating film when exposed to the fuel cell environment which provides a barrier to further oxidation/corrosion of the underlying coating.

While the invention has been described in terms of specific embodiments thereof it is not intended to be limited thereto but rather only to the extent set forth hereafter in the claims which follow.

What is claimed is:

1. In a PEM fuel cell having at least one cell comprising a pair of opposite polarity electrodes, a membrane electrolyte interdigitated said electrodes for conducting ions therebetween, and an electrically conductive contact element having a working face confronting at least one of said electrodes for conducting electrical current from said one electrode, the improvement comprising: said contact element comprising a corrosion-susceptible metal substrate and an electrically conductive, corrosion-resistant protective coating on said face to protect said substrate from the corrosive environment of said fuel cell, said protective coating comprising a mixture of electrically conductive particles dispersed throughout an oxidation-resistant and acid-resistant, water-insoluble polymeric matrix and having a resistivity greater than about 50 ohm-cm, said mixture

comprising graphite particles having a first particle size and other electrically conductive particles selected from the group consisting of gold, platinum, nickel, palladium, rhodium, niobium, titanium carbide, titanium nitride, titanium diboride, chromium-alloyed titanium, nickel-alloyed titanium, rare earth metals and carbon, said other particles having a second particle size less than said first particle size to enhance the packing density of said particles.

2. A fuel cell according to claim 1 wherein said carbon comprises carbon black.

3. A fuel cell according to claim 1 wherein said coating is electrophoretically deposited onto said substrate from a suspension of said particles in an aqueous solution of acid-solubilized polymer.

4. A fuel cell according to claim 1 wherein a discrete film of said coating is laminated onto said substrate to form said electrically conductive contact element.

5. A fuel cell according to claim 1 wherein a precursor of said coating is deposited onto said substrate from a solution thereof, dried and cured to form said coating.

6. A fuel cell according to claim 1 wherein said substrate comprises a first acid-soluble metal underlying a second acid-insoluble, passivating metal layer susceptible to oxidation in said environment.

7. A fuel cell according to claim 1 wherein said polymer matrix is selected from the group consisting of epoxies, silicones, polyamide-imides, polyether-imides, polyphenols, fluoro-elastomers, polyesters, phenoxy-phenolics, epoxide-phenolics, acrylics and urethanes.

8. In a PEM fuel cell having at least one cell comprising a pair of opposite polarity electrodes, a membrane electrolyte interdigitated said electrodes for conducting ions therebetween, and an electrically conductive contact element having a working face confronting at least one of said electrodes for conducting electrical current from said one electrode, the improvement comprising: said contact element comprising a corrosion-susceptible metal substrate and an electrically conductive, corrosion-resistant protective coating on said face to protect said substrate from the corrosive environment of said fuel cell, said protective coating comprising a plurality of electrically conductive particles dispersed throughout an oxidation-resistant and acid-resistant, water-insoluble polymeric matrix and having a resistivity no greater than about 50 ohm-cm, said substrate comprising a first acid-soluble metal underlying a second acid-insoluble, passivating layer susceptible to oxidation in said environment.

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